Overview of NPOL Radar Operations and Preliminary Analysis from CRYSTAL-FACE

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Overview of NPOL Operations

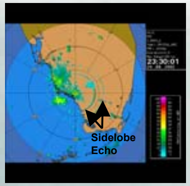
- The NASA NPOL is a S-band polarimetric radar that was recently developed at NASA Wallops. The radar features a lightweight mesh antenna and efficient wave guide design which makes the radar facility more portable compared to other S-band radar systems. The dual polarimetric scanning capability provides radar scientists with information on hydrometeors shape, size, and phase that cannot be determined with conventional radar (e.g., NEXRAD and allow for more accurate rainfall estimates compared to the standard Z-R methodology.

-For CRYSTAL-FACE, the NPOL radar had two primary objectives: (1) collect a continuous dataset for both rainfall mapping and hydrometeor identification; and (2) support CRYSTAL-FACE aircraft operations. Multiple tilt "volume" scans were scheduled during aircraft missions and during times of active weather to examine the 3-D structure of precipitation. The volume scans provided crucial information on the vertical structure of convection in support of aircraft vectoring. Low elevation tilt " rain" scans were conducted during as much of the filed program as possible in order to provide a data base that could be used for numerical model validation of rainfall.

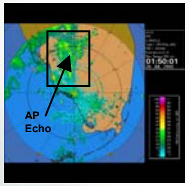
- NPOL radar started preliminary data collection and testing on July 1. Continuous 24 hour a day operations started on July 5 and ended on July 29. NPOL was only down for one aircraft mission (July 11). During that mission, WSR-88D radar products from the surrounding radars were used to assist in aircraft operations.

- NPOL was operated on a 10 min scan repeat sequence starting the top of each hour. Data collected within the 10 min period started with a 3 tilt rain map scan followed by a 19 tilt full volume scan. If time permitted, a long range surveillance scan or range height indicator (RHI) scans were scheduled at the end of the 10 min period. Volume scans were not scheduled during inactive, non-flight periods. Therefore, the total number of NPOL volume scans are less than the rain scans. NPOL collected 3014 rain scans and 2145 volume scans during CRYSTAL FACE.

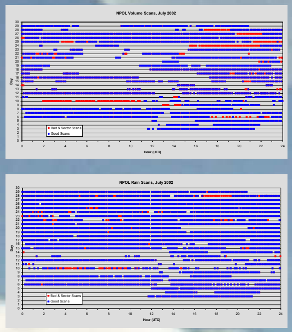
Sidelobe Example



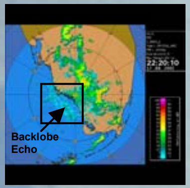
Strong AP Example



NPOL Data Availability



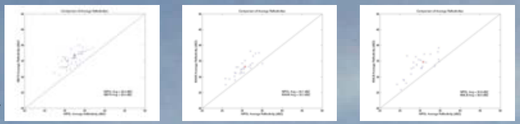
Strong Backlobe Example

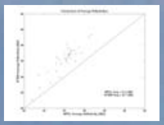


DATA Quality Control Issues

- Spurious echoes associated with side and back lobes; Occurred 6% in rain scans and 5% in volume scans
- Strong anomalous propagation (AP); Occurred 7% in rain scans and 9% in volume scans
- Significant power loss when the antenna was wet (8-12 dB); Occurred 3% in both rain and volume scans
- Polarimetric data quality issues: differential reflectivity (ZDR) bias and large noise in the phase (PhiDP; KDP) and linear depolarization ratio (LDR) data

NPOL – WSR-88D Radar Reflectivity Intercomparison

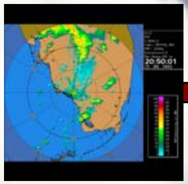


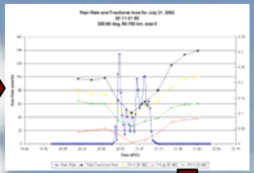


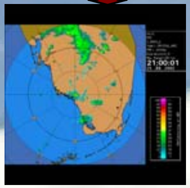
Radar Reflectivity Comparison

- Radar reflectivity was compared between NPOL and the four surrounding WSR-88D radars (Key West, Melbourne, Miami, Tampa Bay) in the overlap region
- Cases were carefully selected to eliminate possible contamination from ground clutter, AP, side and back lobes
- Reflectivity data were linearly averaged common region for 10 dBZ < reflectivity < 60 dBZ
- Comparison show that NPOL is from 2.6 – 5.9 dB lower than WSR-88D
- A correction of 2 – 3 dB can be explained by NPOL calibration corrections
- Further comparisons will be made with the polarimetric parameters and with independent PR measurements

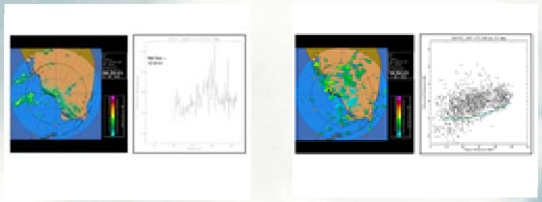
Wet Antenna Example



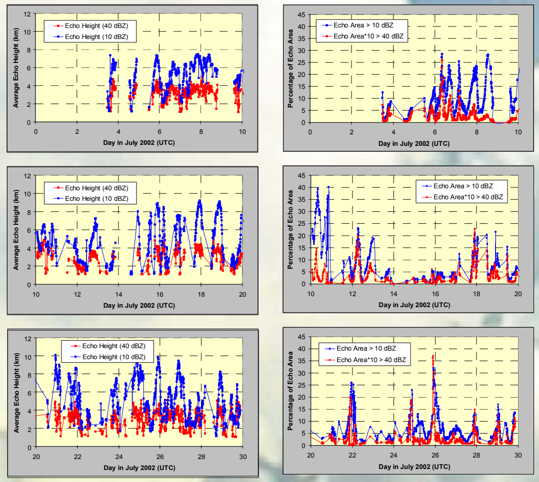




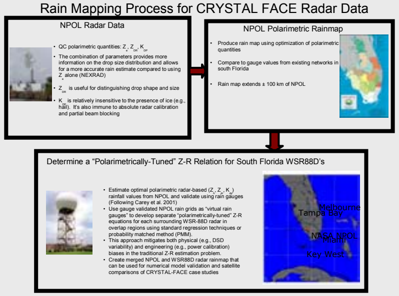
Polarimetric Analysis



NPOL Echo Summary Statistics



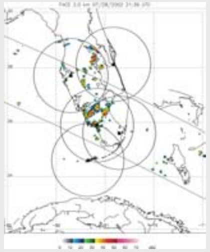
Rain Mapping Process for CRYSTAL FACE Radar Data

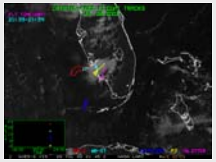


Merged Radar Rainfall Product Domain

Grid domain:
22-30° N Lat x 77-85° W Lon
Spatial Resolution:
4 x 4 km horizontal x 2 km vertical from 2 – 12 km in altitude
Temporal resolution:
nominally 6 min.

Example Merged Radar Product with TRMM Overpass
Case Study 2140 UTC 28 July 02





Remaining Quality Control and Data Processing Issues

- Removal of ground clutter using polarimetric techniques
- Removal of meteorological artifacts: sidelobe and backlobe returns, AP, and second trip echo
- Bias adjustments due to engineering calibration corrections
- Removal of scan during wet antenna periods
- Removal of the bias in the ZDR data
- Assessment of the phase and LDR data

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